

WHAT IS CLAIMED IS:

1. A method of polishing or planarizing a substrate comprising abrading at least a portion of the surface of a substrate comprising a metal, metal oxide, metal composite, or mixture thereof, with a composition comprising a metal oxide abrasive and a liquid carrier, wherein the composition has a pH of about 7 or less and the metal oxide abrasive has a total surface hydroxyl group density no greater than about 3 hydroxyl groups per nm².
- 10 2. The method of claim 1, wherein the substrate comprises a metal.
- 15 3. The method of claim 2, wherein the metal of the substrate is selected from the group consisting of copper, aluminum, titanium, tungsten, gold, platinum, iridium, ruthenium, and combinations thereof.
- 15 4. The method of claim 3, wherein the metal of the substrate is tungsten.
- 20 5. The method of claim 1, wherein the substrate comprises a metal oxide.
- 25 6. The method of claim 5, wherein the metal oxide of the substrate is selected from the group consisting of alumina, silica, titania, ceria, zirconia, germania, magnesia, and combinations thereof.
- 30 7. The method of claim 6, wherein the metal oxide of the substrate is silica.
8. The method of claim 1, wherein the substrate comprises a metal composite.
9. The method of claim 2, wherein the metal composite of the substrate is titanium nitride, tungsten nitride, and nickel-phosphorus.

10. The composition of claim 1, wherein the metal oxide abrasive is selected from the group consisting of alumina, silica, titania, ceria, zirconia, germania, magnesia, and combinations thereof.

5 11. The composition of claim 10, wherein the metal oxide abrasive is silica.

12. The composition of claim 11, wherein the metal oxide abrasive is fumed silica.

10 13. The method of claim 1, wherein the total surface hydroxyl group density is no greater than about 2.8 hydroxyl groups per nm².

15 14. The method of claim 13, wherein the total surface hydroxyl group density is no greater than about 2.5 hydroxyl groups per nm².

15. The method of claim 1, wherein the pH of the polishing composition is about 6 or less.

20 16. The method of claim 15, wherein the pH of the polishing composition is about 5 or less.

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